(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number : **0 418 865 B1**

(12) # EUROPEAN PATENT SPECIFICATION

(45) Date of publication of patent specification : **05.07.95 Bulletin 95/27**

(51) Int. Cl.[6] : **H04L 12/56,** H04Q 7/22

(21) Application number : **90118036.4**

(22) Date of filing : **19.09.90**

(54) **Wireless signal transmission system with random access.**

(30) Priority : **19.09.89 JP 240822/89**

(43) Date of publication of application : **27.03.91 Bulletin 91/13**

(45) Publication of the grant of the patent : **05.07.95 Bulletin 95/27**

(84) Designated Contracting States : **DE GB SE**

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EP 0 418 865 B1

Description

The present invention generally relates to a wireless signal transmission systems and particularly to a wireless signal transmission system in which a plurality of terminal stations make access to a central station at random, thereby to transmit signals thereto.

The slotted ALOHA system and the ICMA (Idle Signal Casting Multiple Access) system are known, in which a plurality of terminal stations access the central station at random. The ICMA system is particularly advantageous, if a long signal is to be transmitted.

However, when the LAPB (described later) or specific layer-2 procedure of protocol such as extended LAPB is employed in these conventional communication systems, the systems will have a very low transmission efficiency. This is because signal transmission though the upward links is limited due to signal collision, though data transmission through the upward links needs to be balanced with the data transmission through the downward links.

To obtain a good throughput characteristic of a random access system, signals are transmitted through the upward links to such extent that the signal collision rate exceeds, for example, 0.2, and the reliability of the system is ensured by re-transmitting the signals.

The LAPB is equivalent to the balanced HDLC (high level data link control) transmission system. The word "balanced" means that a transmission terminal and a reception terminal are on an equal footing.

In the HDLC system, a transmitting station transmits a signal including 16-bit check codes to a receiving station. If the receiving station detects an error in the signal, it output a re-transmission request to the transmitting station, requesting that the transmitting station re-transmit the signal. More specifically, retransmission control is performed, wherein the transmitting station re-transmits the message, and the receiving station supplies, upon receipt of the re-transmitted message, a layer-2 acknowledge signal to the transmitting station, thus acknowledging the receipt of the message. The reliability of the HDLC system is thereby ensured.

Fig. 6 shows a signal structure according to the conventional LAPB format. As is shown in this figure, a signal to be transmitted contains a frame synchronizing flag F, a control code C, transmission data D, and a check code CRC. The check code CRC is comprised of bits and obtained by a specific generation polynomial equation. The check code CRC is added to data (C+D). The receiving station detects an error in the data (C+D+CRC) received, and transmits a control code C to the transmission terminal, informing whether or not the signal has been correctly received. If NO, the transmitting station re-transmits the signal to the receiving station.

When the above-described communication procedure is applied to random access in a mobile digital communication, especially when the central station transmits a massage through a downward link to a terminal station, and the terminal station transmits, upon receipt of the message, a layer-2 acknowledge signal through the upward link at random the central station, the acknowledge signal collides another signal in another upward link at high probability. Consequently, the signal may not reach the central station.

If the the central station does not receive the signal within a predetermined period of time, it retransmits the message to the terminal station through the downward link. Obviously, this results in a low transmission efficiency and a great transmission delay, particularly when the message is long.

Document "IEEE Transactions on Vehicle Technology", vol. 38, no. 2, February 1989, New York, pages 50 - 54, decribes an ICMA system with a decreased propability of collision between an acknowledge signal and a transmission signal. In this article, a digital wireless communication method for transferring data between a plurality of terminal stations and a central station with random access is disclosed. According to this method, in the central station an achnowledge signal based on a signal transmitted from one of the terminal stations to the central station is generated and is transmitted to the terminal station. Then, it is determined whether or not the central station has correctly received the signal which has been transmitted from the terminal station to the central station. Thereafter, the transmission of signals from the concerning terminal station is suspended for a predetermined period of time if the resultant of this determining step is not correct. Thus, a collision of signals is avoided until the resultant of the determining step is correct.

It is an object of the present invention to provide a new and improved wireless signal transmission system with random access, in which an effective data transmission is achieved by use of the LAPB or layer-2 procedure of a protocol as an extended LAPB, and general-purpose data transmission is achieved by use of the known layer-2 procedure or the extended layer-2 procedure.

To achieve the object, a central station generates data in accordance with a predetermined rule based on a signal transmitted from a terminal station. (This data includes, for example, part of the signal, an identification number of the terminal station, or the results of the predetermined logical operation using the data and the identification number.) The central station transmits the data to the terminal station. The terminal station compares this data with data which is generated in accordance with the same rule as the predetermined rule at the central station, based on data restored in the terminal station, determines whether or not the central station has correctly received the signal from the terminal station. If NO, the terminal

station suspends the signal transmission for a predetermined period of time.

According to a first aspect of the invention, there is provided a digital wireless communication method for transferring a data message between a plurality of terminal stations and a central station with random access, whereby said data message is divided into a plurality of burst signals for transmission in a number required by the length of the data message and of which the first burst signal contains data indicating the length of the message, the method comprising the steps of preparing and transmitting, in the central station , data of a transmission format including an I/B bit indicating permission or inhibition of a new data message transmission at a next transmission timing of the terminal stations, in accordance with the number of the burst signals required by the length of the data message that has been received from the terminal station at the central station , an R/N bit indicating reception or non-reception of burst signals from the terminal stations at the central station , and partial data produced from data received at the central station in accordance with a predetermined rule based on the signals received from the terminal stations ; preparing data indicating the length of a data message to be transmitted from each terminal station; starting the new data message transmission of the burst signal or burst signals containing the data indicating the length of the message, from one or plural of the terminal stations to the central station when the I/B bit indicates the permission of the new data message transmission; determining and transmitting, in the central station, the I/B bit, the R/N bit , and the partial data in accordance with the reception of the data indicating the length of the message and the rest of the first burst signal transmitted from one of the terminal stations if it was the first burst signal, or in accordance with the reception of the burst signal transmitted from one of the terminal stations if it was not the first burst signal; determining, in the one or plural of the terminal stations which have been transmitting, whether or not the burst signal has been correctly received at the central station, in accordance with the R/N bit and the partial data from the central station, and determining whether or not the I/B bit permits or inhibits a further burst signal; and suspending transmission of burst signals from one or plural of the terminal stations, for a predetermined period of time, when it is determined that the burst signal has not been correctly received at the station.

According to a second aspect of the invention, there is provided a mobile digital communication apparatus for transferring a data message between a plurality of terminal stations and a central station with random access, whereby said data message is divided into a plurality of burst signals for transmission in a number required by the length of the data message and of which the first burst signal contains data indicating the length of the message, the apparatus comprising means for preparing and transmitting, in the central station , data of a transmission format including an I/B bit indicating permission or inhibition of a new data message transmission at a next transmission timing of the terminal stations, in accordance with the number of the burst signals required by the length of the data message that has been received from the terminal station at the central station , an R/N bit indicating reception or non-reception of burst signals from the terminal stations at the central station , and partial data produced from data received at the central station in accordance with a predetermined rule based on the signals received from the terminal stations ; means for preparing data indicating the length of a data message to be transmitted from each terminal station and starting the new data message transmission of the burst signal or burst signals containing the data indicating the length of the message, from one or plural of the terminal stations to the central station when the I/B bit indicates the permission of the new data message transmission; means for determining and transmitting, in the central station, the I/B bit , the R/N bit and the partial data in accordance with the reception of the data indicating the length of the message and the rest of the first burst signal transmitted from one of the terminal stations if it was the first burst signal, or in accordance with the reception of the burst signal transmitted from one of the terminal stations if it was not the first burst signal; means for determining, in the one or plural of the terminal stations which have been transmitting, whether or not the burst signal has been correctly been transmitted, whether or not the burst signal has been correctly received at the central station, in accordance with the R/N bit and the partial data from the central station, and determining whether or not the I/B bit permits or inhibits a further burst signal; and means for suspending transmission of burst signals from the one or plural of the terminal stations, for a predetermined period of time, when it is determined that the burst signal has not been correctly received at the station.

This invention can be more fully understood from the following detailed description when taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a diagram illustrating a terminal station incorporated in a system according to the present invention;

Fig. 2 is a diagram showing the central station incorporated in the system according to the present invention;

Fig. 3 is a diagram representing the format of a signal transmitted through the downward link of the system;

Fig. 4 is a diagram representing the format of a signal transmitted through the upward link of the system;

Fig. 5 is a diagram explaining the operation of the system according to the invention; and

Fig. 6 is a diagram illustrating the format of a signal transmitted in the conventional LAPB system.

Reference will now be made in detail to the presently preferred embodiment of the invention as illustrated in the accompanying drawings, in which like reference characters designate like or corresponding parts throughout the several drawings.

Fig. 1 is a block diagram showing one of the terminal stations incorporated in a digital mobile communication system according to this invention. As is shown in Fig. 1, the terminal station comprises an encoding circuit 11, a logic operation circuit 12, a transmitting circuit 13, a modulating circuit 14, a demodulating circuit 15, an signal extraction circuit 16, and a decoding circuit 17.

Fig. 2 is a block diagram illustrating the central station of the digital mobile communications system. As is shown in Fig. 2, the central station comprises a demodulating circuit 21, a signal extraction circuit 22, a decoding circuit 23, a logic operation circuit 24, an indication control circuit 25, an encoding circuit 26, a signal-multiplexing circuit 27, and a modulating circuit 28.

Fig. 3 illustrates the format of a signal transmitted through the downward link of the system. As this figure shows, the signal consists of units, each comprised of a first slot (S1) 31, a second slot (S2) 32, and a third slot (S3) 33. Each slot has a frame synchronization word 34, an indication signal 35, and data 36. To perform error control, check bits (not shown) are set at the end of the signal format. Each indication signal 35 consists of data 37 pertaining to permission for a new transmission of the terminal station at a next transmission timing of the terminal station, and part of the signal transferred from the terminal station. The data 37 is "I" to permit the transmission of a signal; it is "B" to inhibit the transmission of the signal. The data 38 is "R" to inform the correctly reception of a signal; it is "N" to inform the incorrectly reception or non-reception of the signal. There are several techniques available for generating the partial data 39, which will be described later.

Fig. 4 represents the format of a signal transmitted through the upward link of the system according to the embodiment of the invention. As this figure shows, the signal consists of units, each comprised of a first slot (S1) 31, a second slot (S2) 32, and a third slot (S3) 33. Also shown in Fig. 4 are upward link burst signals 41 con-tained in specific slots, i.e., the second slots S2. Each upward link burst signal consists of a synchronization signal 42, a frame synchronizing signal 43, and upward link data 45. The signal 41, shown leftmost in Fig. 4, contains data 44 (typically the signal length W of a transmitting signal) pertaining to the structure of a message. When the data to be transmitted contains a plurality of slots, the number of these slots is loaded in the first slot. The check bits for error control are usually allocated at the end of the signal format. As is shown in Fig. 3, the signal format according to this embodiment is a sequence of slots of various kinds, and random access control which provides for the I/B data is utilized for each slot.

More specifically, the upward link data is divided into a plurality of bursts for transmission in a number required by the length of the message. The first burst contains, as shown in Fig. 4, data 44 pertaining to the structure of the message and also the number of bursts constituting that message. The down I/B data 37 indicates wether transmission permitted or transmission inhibited, in accordance with the number of the bursts W, thereby protecting a signal being transmitted from one terminal station against collision with signals being transmitted from the other terminal stations.

In other words, when the central station receives a signal W=3, B is set for the two consecutive slots that are assigned for use by the terminal station. In the example illustrated in Fig. 4, a bit synchronization signal of a second burst is shorter than that of the first burst since the second burst is received after bit synchronization has been established in the first burst and retained, and a large field is provided for the upward link data by omission of the information pertaining to the signal structure. The operations of the terminal station and central station in transmitting an up message according to this embodiment will be described.

To transmit a message from the terminal station through the upward link, the encoding circuit 11 encodes the message, thus forming, for example, error correcting codes. The message is then input to the transmitting circuit 13, so that it can be transmitted to the central station. Partial data resulting from fixed initial processing is input to the transmitting circuit 13 and stored therein. (The partial data is that part (e.g., the first 10 bits or the last 10 bits of the upward information bits) of the upward link data to be transmitted.)

The data is demodulated by the demodulation circuit 15 is supplied to the transmission control circuit 13 after the indication signal 35 (Fig. 3) has been separated by the signal extraction circuit 16. When the I/B data indicates permission (I), transmission is commenced from the first burst in the next slot timing.

The central station receives the burst signal. In this station, the demodulating circuit 21 demodulates the burst signal, and the signal extraction circuit 22 processes the demodulated signal. The data representing the number of the message-constituting bursts contained in the first burst is input to the indication control circuit 25. In the meantime, the decoding circuit 23 decodes the upward link data, thereby correcting errors, etc. The upward link data, thus decoded, is input to the logic opera-tion circuit 24, whereas the partial data resulting from the same

processing performed in the logic operation circuit 12 of the terminal station is input to the indication control circuit 25, thus taking out the partial data received.

The decoding circuit 23 detects errors and supplies a signal to the indication control circuit 25, informing whether or not the signal has been received. The indication control circuit 25 sets bits 37, thereby permitting or inhibiting transmission in accordance with the value of W, and also sets bit of the R/N data, thus informing whether or not the signal has been received. If the bit is "R," it indicates that the signal has been received. If the bit is "N," it indicates that the signal has not been received. The partial data so taken out is incorporated into the indication signal 35. The indication signal 35 is transmitted via the signal-multiplexing circuit 27 and modulation circuit 28.

In the terminal station, the indication signal 35 is supplied to the transmitting circuit 13 through the demodulation circuit 15 and the signal extraction circuit 16. If the R/N information 38 output by the signal extraction circuit 16 is "R," indicating the receipt of the transmitted data, the transmitting circuit 13 compares the partial data 39 with that one stored in the logic operation circuit 12 prior to the transmission. If the compared data pieces are identical, the circuit 13 determines that the data transmitted has been correctly received, and transmits the next burst. Alternatively, the circuit 13 stops transmitting the next burst if the message is short and requires only one burst.

When the R/N information 38 indicates non-reception, or when the partial data 39 is not identical to the stored partial data, the transmitting circuit 13 is held in a waiting state for re-transmitting the data from the first burst. Immediately, or upon lapse of a period of time, the circuit 13 starts again to transmit the data when the bit 37 indicates the transmission permitted.

Fig. 5 is a diagram explaining the operation of the system according to the the invention.

Assume that terminal stations 1 and 2 are to transmit a message "1 a b c" of a length W=1 (number of bursts) and a message "2 m n o" of a length W=1, respectively, immediately prior to time A. Let us further assume that the two message signals are simultaneously transmitted at time A in response to instructions of transmission-permitted (I) and a collision occurs between the two message signals. In this case, if the level of the message transmitted from the terminal station 2 is higher than that of the message transmitted from the terminal station 1, the message from the terminal station 2 survives. Since W=1, the central station transmits a signal, in the next slot, to the the surviving terminal station, informing that the transmission has been permitted and that the partial data has been received.

The terminal station 2 then stops transmitting the message since the partial data is identical to the stored one, while the terminal station 1 is held in the waiting state for re-transmission due to non-coincidence. If re-transmission takes place at time B, and the re-transmitted signal collides with a signal from a terminal station 3, and if either signal reaches the terminal station 1, the terminal station 1 is again brought into the waiting state since transmission permitted, non-reception of signal (N), and the receipt of the partial data (X) are notified in the next slot. The terminal section 2 therefore re-transmit data at time C. If the re-transmitted data is correctly received at the central station, the terminal station receives, in the next slot, a signal indicating transmission permitted (I), signal received (R), and partial data received (1). The coincidence of the transmitted data with the stored causes the terminal station 1 to complete transmission of the message "1 a b c".

To transmit a W=2 message "1 e f g h i j k", the terminal station 1 starts transmission upon receipt of the signal indication transmission permitted (I), at time D. Since W=2, it is notified of transmission inhibited (B), signal received (R), and partial data received (1). Since there is a coincidence between both of the partial data, the terminal station 1 transmits a second burst. In the next step, it receives a signal indicative of transmission permitted (I), signal received (R), and partial data received (1), and thus stops the transmitting operation.

Since transmission is effected by utilizing a region of high throughput and automatic re-transmission is effected where the probability of collision is relatively high, the invention provides a high degree of reliability of up signals to permit bi-directional information transmission to be effectively performed by utilizing a fixed layer 2 procedure.

Since re-transmission of data occurring at the time of collision in up random access is achieved without relying on the communications procedure, complex control of the communication procedure is unnecessary, and re-transmission time suitable for random access can be set, so that transmission delay can be advantageously minimized.

When the message is formed of a plurality of bursts, a technique for checking partial data in respect of each burst has been described above. Where it is sufficient to only identify which one of data has been received at the time of collision, only the first burst may be checked, since if the first burst has been correctly received, the data I/B is rendered B in the next burst and no collision occurs with respect to the second and subsequent bursts. The partial data has been explained as being obtaining by performing a logical operation on reproduced data which has been error corrected at the central station. When, however, no independent error correction can be made or when such corrections take much time since error correction has been made over the bit interleave and a plurality of bursts, the partial data may be produced by directly subjecting the received data to logic operation

processing without correcting an error.

In this case, when a signal error has been generated, erroneous partial data is returned to the terminal station. This creates no problems since such partial data is treated as non-coincident at the terminal station.

The partial data can be provided by taking out a part of the bit array of the message in 10 bits or so, as described above, but may also be by taking out 10 bits or so from appropriate plural points of the bit array of the upward link data 45 and by adding the bits or Ex-ORing each bit.

Further, the upward link data 45 has a portion that corresponds to the identification number ID of the terminal station, so that partial data may be produced by taking out a part or the whole of the bits in such portion. Still further, operation results of part of the ID and part of the other data may be utilized. If 14 bits are allocated for partial data, a probability for the coincidence of two partial data pieces obtained from two data pieces is $1/2^{14} \fallingdotseq 10^{-5}$ in the case of a 14-bit partial data, the rate of collision is 0.2, and the probability of survival at the time of collision is 0.5. The probability for a given terminal station to determine erroneously that transmission is completed, despite non-reception at the central station may be kept at a small value of the order of 10^{-6}. The number of bits for partial data may be determined to meet requirements for this value.

In general, the transmission of down-data is more effective than the random-access transmission of upward link data. Therefore, to assign 30% or so of a down information field to the partial data does not create any particular problem in attaining well balanced bi-directional information transfer.

Comparison of partial data with another one may be effected not only for detecting coincidence of data to the fullest extent, but may utilize a technique allowing an error in one bit or so considering a transmission error. Although allowing an error necessarily increases the probability in which partial data from two different terminals come to be casually coincident with each other, the probability of coincidence that can happen by allowing a one bit error to remain, for example, in a 14 bits partial data is on the order of 10^{-4} and is still tolerable.

A technique is valid in which error corrections or majority-vote fashion is utilized for the purpose of this invention to deal with the I/B and R/N information and the partial data.

The foregoing description is limited to the arrangement in which three transmitting slots at the terminal stations are placed one slot after the receiving slot, thus enabling the terminal station to identify the partial data before this station receives the next slot. In the case where the same slot is used in the next cycle in both the transmitting station and the receiving station, the value W can independently decoded in the head portion of the burst, and the signal indicating either transmission permitted or transmission inhibited can be set in the end portion of the burst. Then, the partial data will be transmitted with a delay of one-cycle time.

Although the technique of determining whether or not a signal has been received at the central station has been described by way of detecting an error, the level of the data received or the results of lower-level identification of data can be used for this purpose. Further, the indication of the transmission status has been described as giving information respecting only reception or non-reception, such information may validly include the nature of non-reception (for example, non-reception due to thermal noise when the reception level is low; non-reception due to signal collision when the reception level is high but a coding error exists), so that re-transmission may be instructed depending upon the nature of the error. For example, in the event of non-reception due to thermal noise, immediate re-transmission may be instructed, while in the case of non-reception due to collision, re-transmission may take place after the lapse of a random time delay to avoid re-collision.

The bits 38 (Fig. 3) representing a reception or non-reception of data may occupy a common field with the bits 39 for partial data.

More particularly, partial data is unnecessary in the case of non-reception. Thus, a field formed by combining the bits 38 indicating reception or non-reception and the bits 39 assigned for partial data can be used to express a specific pattern (e.g., all-one bits) in order to show non-reception, and this same field may be used in receiving partial data. When the partial data is identical to a specific pattern, several of the pattern bits may be forcedly processed, such as by inverting the first three bits.

When the number of bits forming the partial data is large, the partial data can still be reproduced from the data merely decoded from the noise, without determining whether or not the data has been received, for example, by omitting the bits representing reception/non-reception of data. Reference to the partial data provides correct judgment on the reception and non-reception of data with high accuracy.

Assigning so many bits to the partial data does not particularly jeopardize a well balanced bi-directional information transmission. But, when a further increase of efficiency of down transmission is particularly desired, a technique may be validly used in which additional bits may be accommodated for indicating whether the data in the field used for the partial data represents downward link data or partial data, such that the bits may notify the presence of the partial data only when this data is necessary and the subsequent bits may be used to transmit downward link data. In random access to the system by a plurality of

transmitters and receivers using the same frequency (for example, in a mobile communication system having sectors, each comprising transmitters and receivers and using a specific frequency), it is possible that two or more signals are received simultaneously. In this case, it suffices to supplying partial data items, whereby a very high efficient information transmission is accomplished.

The foregoing description has referred to vacant line control. But the technique of notifying partial data to a pure ALOHA or slotted ALOHA system may be used.

As has been described, regions of high throughput are used in this invention, so that the reliability of up-signals is high in situations where probability of collision is relatively high, with the result that bi-direction data-transmission can be achieved by use of the fixed layer-2 procedure.

Since re-transmission is performed at the time of collision in random access operation, independently of an upper layer, no management more complex than the upper layer is required, and moreover, transmission delays are minimized by setting the re-transmission time at a value suitable for random access.

Claims

1. A mobile digital communication method for transferring a data message between a plurality of terminal stations (1) and a central station (2) with random access, whereby said data message is divided into a plurality of burst signals for transmission in a number required by the length (W) of the data message and of which the first burst signal contains data (44) indicating the length (W) of the message,
characterized in that
the method comprises the steps of
preparing and transmitting, in the central station (2), data of a transmission format including
an I/B bit (37) indicating permission or inhibition of a new data message transmission at a next transmission timing of the terminal stations, in accordance with the number of the burst signals required by the length (W) of the data message that has been received from the terminal station (1) at the central station (2),
an R/N bit (38) indicating reception or non-reception of burst signals from the terminal stations (1) at the central station (2), and
partial data (39) produced from data received at the central station (2) in accordance with a predetermined rule based on the signals received from the terminal stations (1);
preparing data (44) indicating the length (W) of a data message to be transmitted from each terminal station;
starting the new data message transmission of the burst signal or burst signals containing the data (44) indicating the length of the message, from one or plural of the terminal stations to the central station when the I/B bit (37) indicates the permission of the new data message transmission;
determining and transmitting, in the central station, the I/B bit (37), the R/N bit (38), and the partial data (39)
in accordance with the reception of the data (44) indicating the length (W) of the message and the rest of the first burst signal transmitted from one of the terminal stations if it was the first burst signal, or
in accordance with the reception of the burst signal transmitted from one of the terminal stations if it was not the first burst signal;
determining, in the one or plural of the terminal stations which have been transmitting, whether or not the burst signal has been correctly received at the central station, in accordance with the R/N bit (38) and the partial data (39) from the central station, and determining whether or not the I/B bit (37) permits or inhibits a further burst signal; and
suspending transmission of burst signals from one or plural of the terminal stations, for a predetermined period of time, when it is determined that the burst signal has not been correctly received at the station.

2. A mobile digital communication apparatus for transferring a data message between a plurality of terminal stations (1) and a central station (2) with random access, whereby said data message is divided into a plurality of burst signals for transmission in a number required by the length (W) of the data message and of which the first burst signal contains data (44) indicating the length (W) of the message,
characterized in that
the apparatus comprises
means for preparing and transmitting, in the central station (2), data of a transmission format including
an I/B bit (37) indicating permission or inhibition of a new data message transmission at a next transmission timing of the terminal stations, in accordance with the number of the burst signals required by the length (W) of the data message that has been received from the terminal station (1) at the central station (2),
an R/N bit (38) indicating reception or non-reception of burst signals from the terminal stations (1) at the central station (2), and
partial data (39) produced from data received at the central station (2) in accordance

with a predetermined rule based on the signals received from the terminal stations (1);
means for preparing data (44) indicating the length (W) of a data message to be transmitted from each terminal station and starting the new data message transmission of the burst signal or burst signals containing the data (44) indicating the length of the message, from one or plural of the terminal stations (1) to the central station (2) when the I/B bit (37) indicates the permission of the new data message transmission;
means for determining and transmitting, in the central station, the I/B bit (37), the R/N bit (38) and the partial data (39)

in accordance with the reception of the data (44) indicating the length (W) of the message and the rest of the first burst signal transmitted from one of the terminal stations (1) if it was the first burst signal, or

in accordance with the reception of the burst signal transmitted from one of the terminal stations (1) if it was not the first burst signal;
means for determining, in the one or plural of the terminal stations which have been transmitting, whether or not the burst signal has been correctly been transmitted, whether or not the burst signal has been correctly received at the central station, in accordance with the R/N bit (38) and the partial data (39) from the central station, and determining whether or not the I/B bit (37) permits or inhibits a further burst signal; and
means for suspending transmission of burst signals from the one or plural of the terminal stations, for a predetermined period of time, when it is determined that the burst signal has not been correctly received at the station.

Patentansprüche

1. Mobiles Digitalkommunikationsverfahren zur Übertragung einer Datennachricht zwischen mehreren Endstellen (1) und einer Zentralstelle (2) mit stochastischem Zugriff, wobei die Datennachricht zur Übertragung in mehrere, der Länge (W) des Datensignals entsprechenden Anzahl von Burst-Signalen aufgeteilt wird, von denen das erste Burst-Signal Daten (44) enthält, die die Länge der Nachricht angeben,
dadurch gekennzeichnet, daß das Verfahren die folgenden Verfahrensschritte aufweist:
in der Zentralstelle (2) Vorbereitung und Übertragung von Daten eines Übertragungsformats umfassend

ein I/B-Bit (37), das die Erlaubnis oder Sperrung einer neuen Datenübertragung zum nächsten Übertragungszeitpunkt der Endstellen in Übereinstimmung mit der für die Länge (W) der von der Zentralstelle (2) empfangenen Datennachricht von der Endstelle (1) erforderlichen Anzahl von Burst-Signalen angibt,

ein R/N-Bit (38), das den Empfang oder Nicht-Empfang von Burst-Signalen von den Endstellen (1) bei der Zentralstelle (2) angibt, und

Teildaten (39), die aus von der Zentralstelle (2) empfangenen Daten in Übereinstimmung mit einer vorgegebenen Regel erzeugt werden, die auf von den Endstellen (1) empfangenen Signalen basiert;
Vorbereitung von Daten (44), die die Länge (W) der von jeder Endstelle zu übertragenden Datennachricht angibt;
Starten einer neuen Datenübertragung des Burst-Signals oder der Burst-Signale, die die Daten (44) enthalten, die die Länge der Nachricht von einer oder mehreren der Endstellen zu der Zentralstelle angeben, wenn das I/B-Bit (37) die Erlaubnis einer neuen Datenübertragung angibt;
Bestimmung und Übertragung des I/B-Bits (37), des R/N-Bits (38) und der Teildaten (39) in der Zentralstelle

in Übereinstimmung mit dem Empfang der Daten (44), die die Länge (W) der Nachricht angeben, und dem Rest des von einer der Endstellen übertragenen ersten Burst-Signals, wenn es das erste Burst-Signal war, oder

in Übereinstimmung mit dem Empfang des von einer der Endstellen übertragenen Burst-Signals, wenn es nicht das erste Burst-Signal war,

Bestimmung in einem oder mehreren Endstellen, die übertragen haben, ob das Burst-Signal von der Zentralstelle korrekt empfangen wurde, in Übereinstimmung mit dem R/N-Bit (38) und den Teildaten (39) von der Zentralstelle, und Bestimmung, ob das I/B-Bit (37) ein weiteres Burst-Signal erlaubt oder sperrt; und
Unterbrechung der Übertragung von Burst-Signalen von einem oder mehreren Endstellen für eine vorgegebene Zeitspanne, wenn bestimmt wurde, daß das Burst-Signal nicht korrekt von der Zentralstelle empfangen wurde.

2. Mobile Digitalkommunikationsvorrichtung zur Übertragung einer Datennachricht zwischen mehreren Endstellen (1) und einer Zentralstelle (2) mit stochastischem Zugriff, wobei die Datennachricht zur Übertragung in mehrere, der Länge (W) des Datensignals entsprechenden Anzahl von Burst-Signalen aufgeteilt wird, von denen das erste Burst-Signal Daten (44) enthält, die die Länge der Nachricht angeben,
dadurch gekennzeichnet, daß die Vorrichtung aufweist:
in der Zentralstelle (2) Mittel zur Vorbereitung und Übertragung von Daten eines Übertragungs-

formats umfassend

ein I/B-Bit (37), das die Erlaubnis oder Sperrung einer neuen Datenübertragung zum nächsten Übertragungszeitpunkt der Endstellen in Übereinstimmung mit der für die Länge (W) der von der Zentralstelle (2) empfangenen Datennachricht von der Endstelle (1) erforderlichen Anzahl von Burst-Signalen angibt,

ein R/N-Bit (38), das den Empfang oder Nicht-Empfang von Burst-Signalen von den Endstellen (1) bei der Zentralstelle (2) angibt, und

Teildaten (39), die aus von der Zentralstelle (2) empfangenen Daten in Übereinstimmung mit einer vorgegebenen Regel erzeugt werden, die auf von den Endstellen (1) empfangenen Signalen basiert;

Mittel zur Vorbereitung von Daten (44), die die Länge (W) der von jeder Endstelle zu übertragenden Datennachricht angibt und, wenn das I/B-Bit (37) die Erlaubnis einer neuen Datenübertragung angibt, zum Starten einer neuen Datenübertragung des Burst-Signals oder der Burst-Signale, die die Daten (44) enthalten, die die Länge der Nachricht von einer oder mehreren der Endstellen (1) zu der Zentralstelle (2) angeben;

Mittel zur Bestimmung und Übertragung des I/B-Bits (37), des R/N-Bits (38) und der Teildaten (39) in der Zentralstelle

in Übereinstimmung mit dem Empfang der Daten (44), die die Länge (W) der Nachricht angeben, und dem Rest des von einer der Endstellen übertragenen ersten Burst-Signals, wenn es das erste Burst-Signal war, oder

in Übereinstimmung mit dem Empfang des von einer der Endstellen (1) übertragenen Burst-Signals, wenn es nicht das erste Burst-Signal war;

in einer oder mehreren Endstellen, die übertragen haben, Mittel zur Bestimmung, ob das Burst-Signal korrekt übertragen wurde, ob das Burst-Signal von der Zentralstelle korrekt empfangen wurde, in Übereinstimmung mit dem R/N-Bit (38) und den Teildaten (39) von der Zentralstelle, und zur Bestimmung, ob das I/B-Bit (37) ein weiteres Burst-Signal erlaubt oder sperrt; und

Mittel zur Unterbrechung der Übertragung von Burst-Signalen von einem oder mehreren Endstellen für eine vorgegebene Zeitspanne, wenn bestimmt wurde, daß das Burst-Signal nicht korrekt von der Zentralstelle empfangen wurde.

Revendications

1. Procédé de radiocommunications numériques du service mobile, permettant de transmettre un message de données entre une pluralité de stations terminales (1) et une station centrale (2) avec accès direct, de sorte que ledit message de données est divisé en plusieurs signaux en salves destinés à être émis en un nombre tel que nécessité par la longueur (W) du message de données et dont le premier signal en salve contient une donnée (44) indiquant la longueur (W) du message,

caractérisé en ce qu'il comprend les opérations suivantes :

préparer et émettre, dans la station centrale (2), des données d'un format de transmission comportant :

un bit I/B (37) indiquant l'autorisation ou l'interdiction d'une nouvelle émission du message de données lors d'un temps d'émission suivant des stations terminales, en fonction du nombre des signaux en salves, nécessité par la longueur (W) du message de données, qui a été reçu de la part de la station terminale (1) dans la station centrale (2),

un bit R/N (38) indiquant la réception ou la non-réception de signaux en salves émanant des stations terminales (1) dans la station centrale (2), et

des données partielles (39) produites à partir des données reçues dans la station centrale (2) selon une règle prédéterminée définie sur la base des signaux reçus de la part des stations terminales (1) ;

préparer une donnée (44) indiquant la longueur (W) d'un message de données à émettre par chaque station terminale ;

faire commencer la nouvelle émission du message de données du signal en salve ou des signaux en salves, contenant la donnée (44) qui indique la longueur du message, par une ou plusieurs des stations terminales à destination de la station centrale lorsque le bit I/B (37) indique l'autorisation de la nouvelle émission du message de données ;

déterminer et émettre, dans la station centrale, le bit I/B (37), le bit R/N (38) et les données partielles (39)

en fonction de la réception de la donnée (44) indiquant la longueur (W) du message et du reste du premier signal en salve émis par l'une des stations terminales s'il s'agissait du premier signal en salve, ou bien

en fonction de la réception du signal en salve émis par l'une des stations terminales s'il ne s'agissait pas du premier signal en salve ;

déterminer, dans celle ou celles des stations terminales qui étaient en train d'émettre, si le signal en salve a ou non été correctement reçu dans la station centrale, en fonction du bit R/N (38) et des données partielles (39) venant de la station centrale, et déterminer si le bit I/B (37)

autorise ou interdit un autre signal en salve ; et

suspendre l'émission des signaux en salves venant d'une ou plusieurs des stations terminales, pendant une durée prédéterminée, lorsqu'il a été déterminé que le signal en salve n'a pas été correctement reçu dans la station.

2. Appareil de télécommunications numériques du service mobile, permettant de transmettre un message de données entre une pluralité de stations terminales (1) et une station centrale (2) avec accès direct, de sorte que ledit message de données est divisé en plusieurs signaux en salves destinés à être émis en un nombre tel que nécessité par la longueur (W) du message de données et dont le premier signal en salve contient une donnée (44) indiquant la longueur (W) du message,

caractérisé en ce qu'il comprend :

un moyen servant à préparer et émettre, dans la station centrale (2), des données d'un format de transmission comportant :

un bit I/B (37) indiquant l'autorisation ou l'interdiction d'une nouvelle émission du message de données lors d'un temps d'émission suivant des stations terminales, en fonction du nombre des signaux en salves, nécessité par la longueur (W) du message de données, qui a été reçu de la part de la station terminale (1) dans la station centrale (2),

un bit R/N (38) indiquant la réception ou la non-réception de signaux en salves émanant des stations terminales (1) dans la station centrale (2), et

des données partielles (39) produites à partir des données reçues dans la station centrale (2) selon une règle prédéterminée définie sur la base des signaux reçus de la part des stations terminales (1) ;

un moyen servant à préparer une donnée (44) indiquant la longueur (W) d'un message de données devant être émis par chaque station terminale et à faire commencer la nouvelle émission du message de données du signal en salve ou des signaux en salves, contenant la donnée (44) qui indique la longueur du message, par une ou plusieurs des stations terminales (1) à destination de la station centrale (2) lorsque le bit I/B (37) indique l'autorisation de la nouvelle émission du message de données ;

un moyen servant à déterminer et à émettre, dans la station centrale, le bit I/B (37), le bit R/N (38) et les données partielles (39)

en fonction de la réception de la donnée (44) indiquant la longueur (W) du message et du reste du premier signal en salve émis par une des stations terminales (1) s'il s'agissait du premier signal en salve, ou bien

en fonction de la réception du signal en salve émis par une des stations terminales (1) s'il ne s'agissait pas du premier signal en salve ;

un moyen servant à déterminer, dans celle ou celles des stations terminales qui étaient en train d'émettre, si le signal en salve a ou non été correctement émis, si le signal en salve a ou non été correctement reçu dans la station centrale, en fonction du bit R/N (38) et des données partielles (39) venant de la station centrale, et à déterminer si le bit I/B (37) autorise ou interdit un nouveau signal en salve ; et

un moyen servant à suspendre l'émission des signaux en salves par la ou les stations terminales, pendant une durée prédéterminée, lorsqu'il a été déterminé que le signal en salve n'a pas été correctement reçu dans la station.

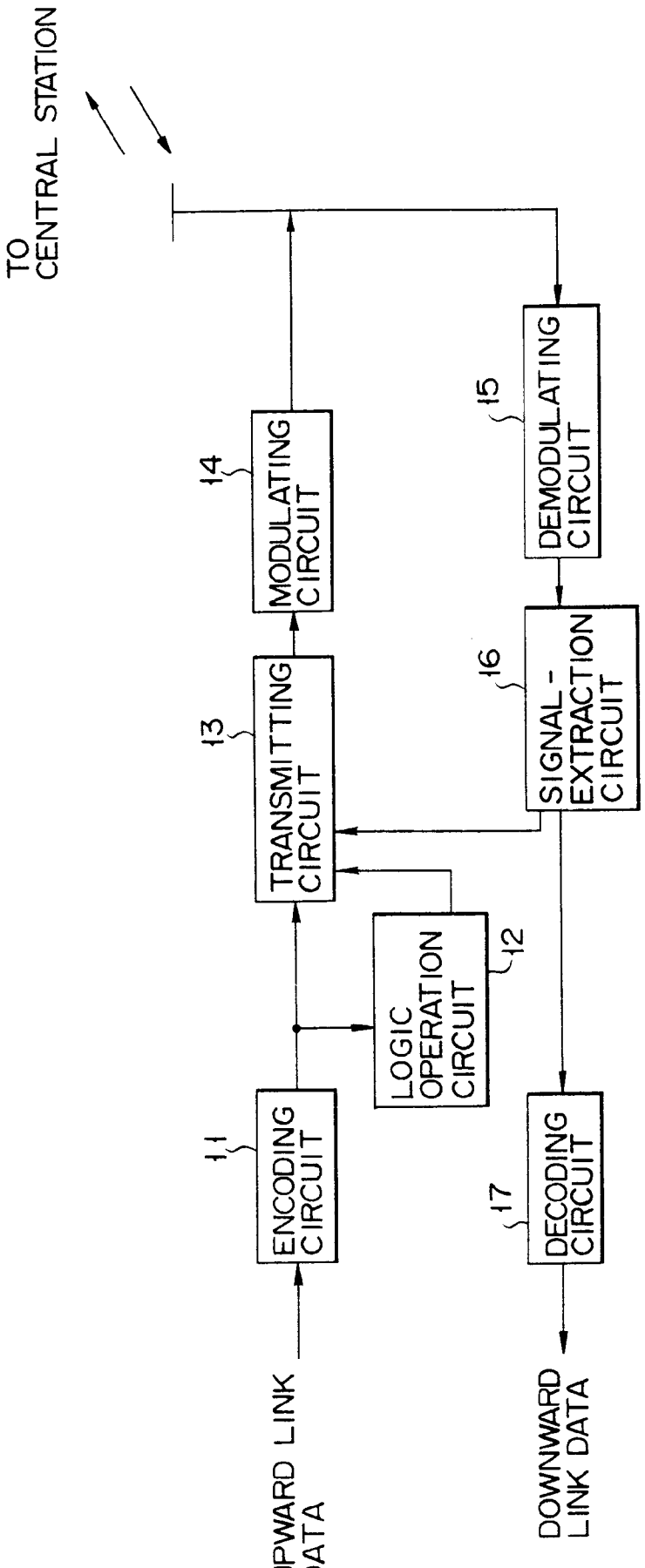
TO CENTRAL STATION
MODULATING CIRCUIT
14
DEMODULATING CIRCUIT
15
TRANSMITTING CIRCUIT
13
SIGNAL - EXTRACTION CIRCUIT
16
LOGIC OPERATION CIRCUIT
12
ENCODING CIRCUIT
11
DECODING CIRCUIT
17
UPWARD LINK DATA
DOWNWARD LINK DATA

FIG. 1

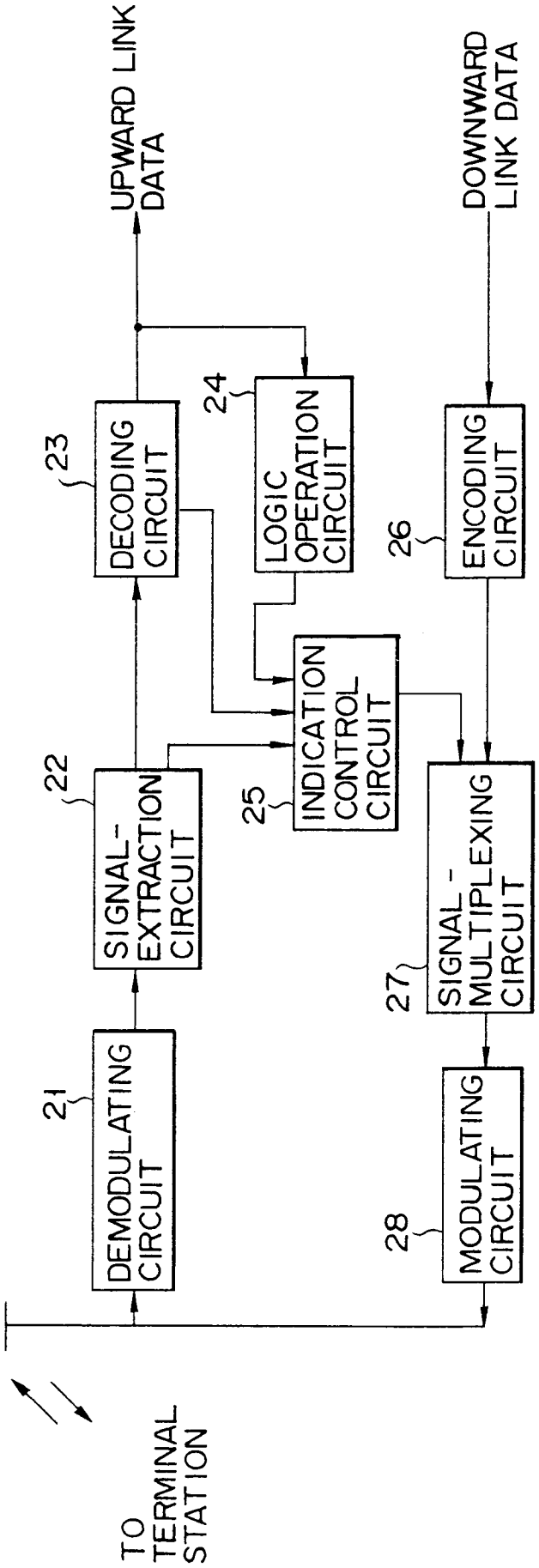
UPWARD LINK DATA
DOWNWARD LINK DATA
23
DECODING CIRCUIT
24
LOGIC OPERATION CIRCUIT
26
ENCODING CIRCUIT
22
SIGNAL-EXTRACTION CIRCUIT
25
INDICATION CONTROL CIRCUIT
27
SIGNAL-MULTIPLEXING CIRCUIT
21
DEMODULATING CIRCUIT
28
MODULATING CIRCUIT
TO TERMINAL STATION

FIG. 2

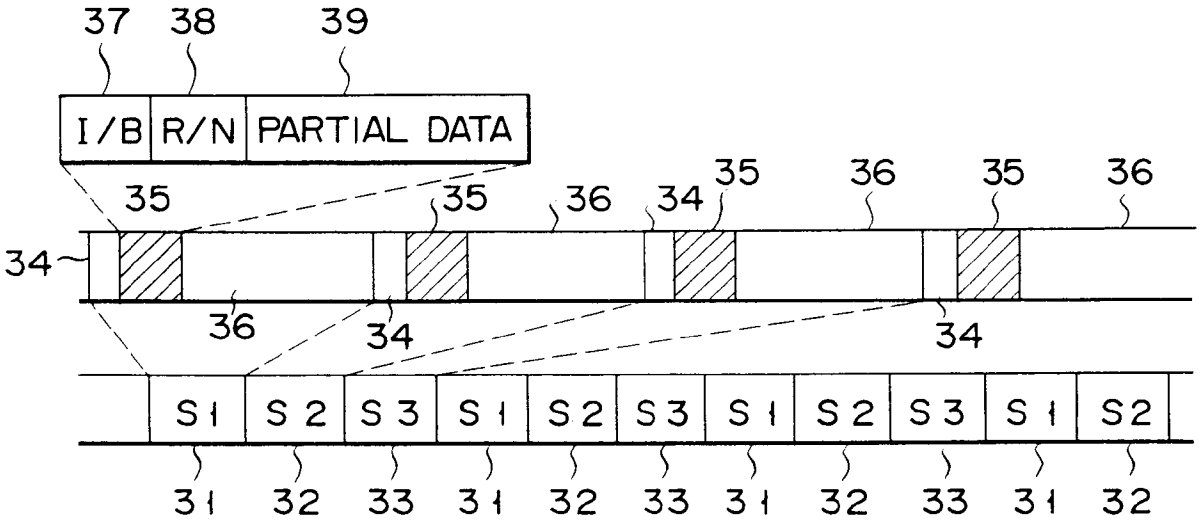
37
38
39
I/B
R/N
PARTIAL DATA
35
35
36
34
35
36
35
36
34
36
34
34
S1
S2
S3
S1
S2
S3
S1
S2
S3
S1
S2
31
32
33
31
32
33
31
32
33
31
32

FIG. 3

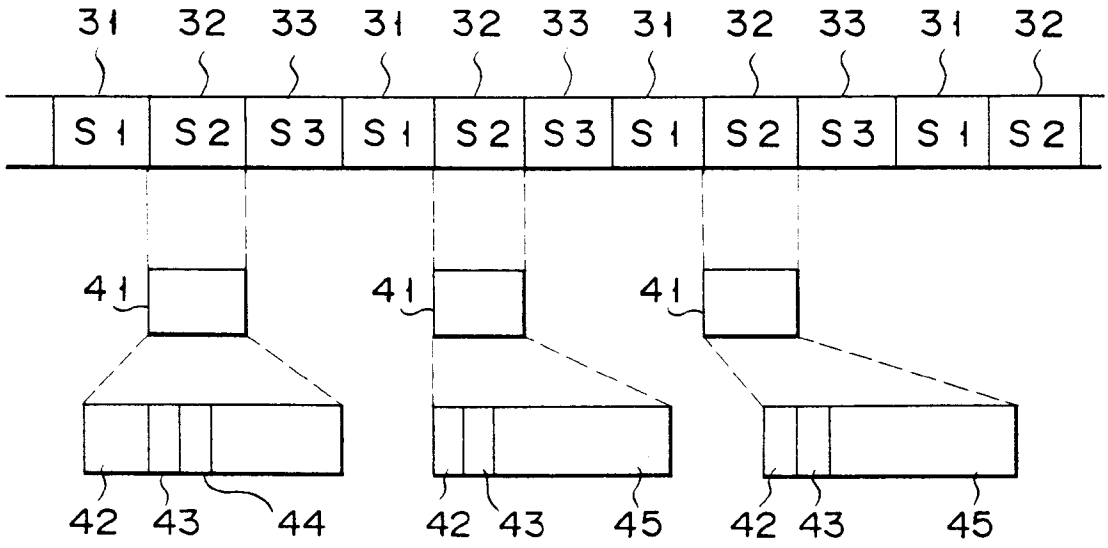
31
32
33
31
32
33
31
32
33
31
32
S1
S2
S3
S1
S2
S3
S1
S2
S3
S1
S2
41
41
41
42
43
44
42
43
45
42
43
45

FIG. 4

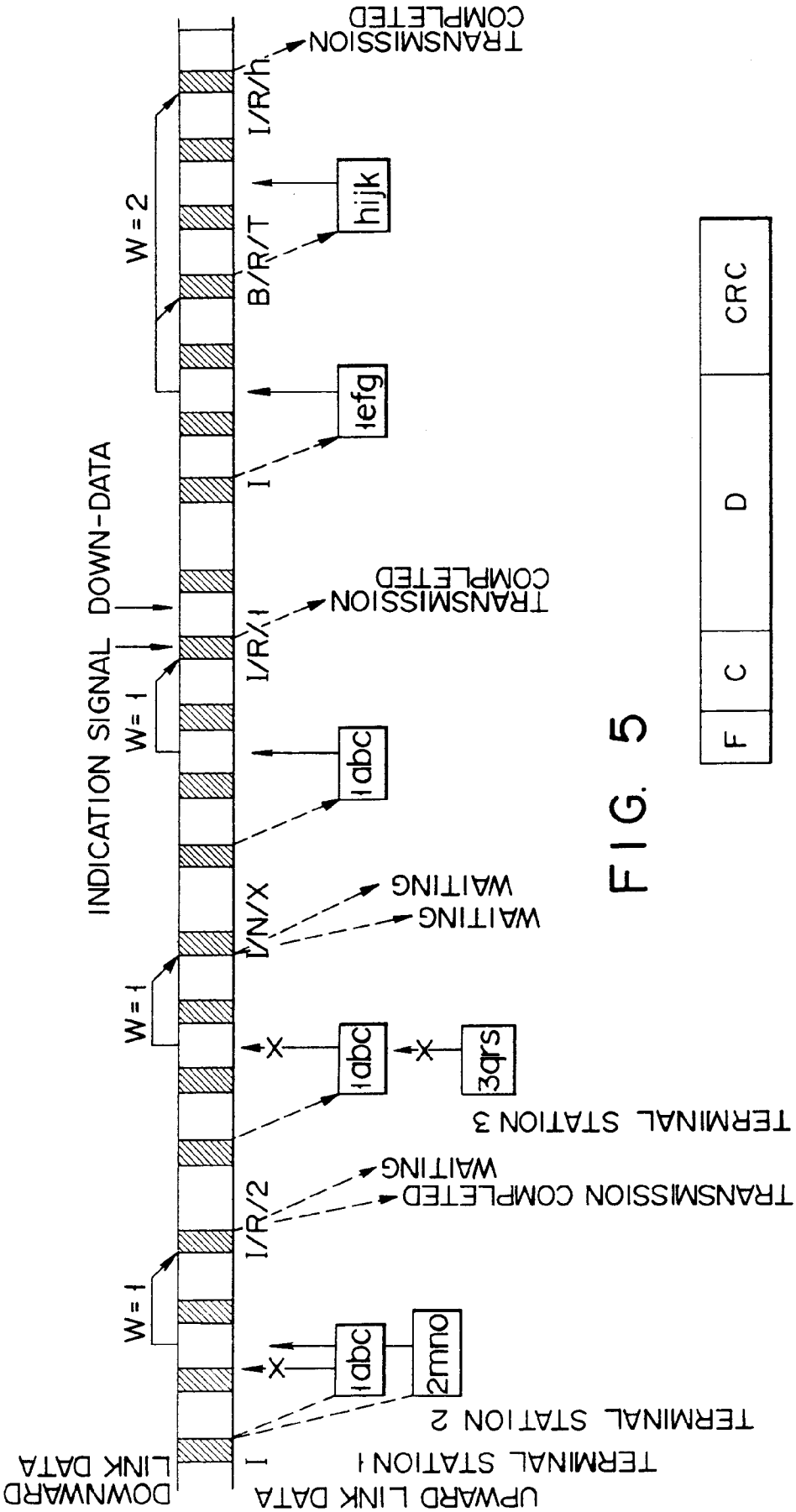
DOWNWARD LINK DATA
UPWARD LINK DATA
TERMINAL STATION 1
TERMINAL STATION 2
TERMINAL STATION 3
TRANSMISSION COMPLETED
WAITING
INDICATION SIGNAL DOWN-DATA
W=1
W=2
I/R/1
I/R/2
I/R/h
B/R/T
I
1abc
2mno
3qrs
1efg
hijk
F
C
D
CRC

FIG. 5

FIG. 6